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IS 4355 (1977): Fire-resistant Brattice Cloth [PCD 13: Rubber and Rubber Products]



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**IS : 4355 - 1977**

( Reaffirmed 2001 )

*Indian Standard*  
SPECIFICATION FOR  
FIRE-RESISTANT BRATTICE CLOTH  
( *First Revision* )

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BUREAU OF INDIAN STANDARDS  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

*Indian Standard*  
SPECIFICATION FOR  
FIRE-RESISTANT BRATTICE CLOTH  
( *First Revision* )

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( Continued from page 1 )

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***Indian Standard***  
**SPECIFICATION FOR**  
**FIRE-RESISTANT BRATTICE CLOTH**  
**( *First Revision* )**

**0. FOREWORD**

**0.1** This Indian Standard ( First Revision ) was adopted by the Indian Standards Institution on 2 June 1977, after the draft finalized by the Treated Fabrics Sectional Committee had been approved by the Chemical Division Council, Mechanical Engineering Division Council and Textile Division Council.

**0.2** Brattice cloth made mainly from jute fabrics is used in large quantities in mines, for the purpose of coursing air around the underground working faces. As a precaution against fire in the mines, it is essential that only fire-resistant brattice cloth should be used.

**0.3** This standard was originally published in 1967. The Committee responsible for the preparation of this standard decided to take up a collaborative testing to establish the requirements of the indigenously produced material. Central Mining Research Station, Dhanbad; Chief Inspectorate of Textiles and Clothing, Kanpur; National Test House, Calcutta; and Indian Jute Industries' Research Association, Calcutta participated in the collaborative investigation. The modifications introduced through this revision are based on the findings of the investigation.

**0.4** In this revision the following important changes have been made:

- a) Requirements for base fabric have been dropped;
- b) Requirements for breaking load have been modified;
- c) Requirement for crease or crack has been dropped; and
- d) A new requirement for electrical resistance has been added for plastic coated brattice cloth.

**0.5** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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\*Rules for rounding off numerical values ( revised ).

## **1. SCOPE**

**1.1** This standard prescribes the requirements and the methods of sampling and test for fire-resistant brattice cloth.

## **2. TERMINOLOGY**

**2.1** For the purpose of this standard, the definitions given in IS: 2244-1972\* shall apply.

## **3. REQUIREMENTS**

**3.1 Base Fabric** — The base fabric shall be jute, cotton or any other fabric of such quality that after treatment it satisfies the requirements prescribed in 3.4.

**3.2 Length and Width** — The length and width of finished fabric shall be as agreed to between the purchaser and the supplier. A tolerance of -5 percent shall be allowed on width.

### **3.3 General Requirements**

**3.3.1** The treatment of the base fabric to make it fire-resistant shall give a minimum effective add-on to avoid excessive increase in mass of the fabric.

**3.3.2** The treatment material shall penetrate the fabric uniformly and adhere firmly to the fabric.

**3.3.3** The treated fabric shall have a reasonable durability under all conditions of usage.

**3.3.4** The treated fabric shall not have any undesirable odour and shall be non-irritant to skin.

### **3.4 Performance Requirements**

**3.4.1 Fire Resistance** — When tested in accordance with the method prescribed in Appendix A, the following conditions shall be fulfilled:

- a) The flame or the glow of the material at any time during the test shall not extend above the marker wire.
- b) After the burner flame has been removed, neither the mean persistence time of the flame on 6 test pieces shall exceed 3 seconds nor the persistence time of the flame on any one test piece shall exceed 10 seconds.
- c) After the burner flame has been removed, neither the mean persistence time of the glow on 6 test pieces shall exceed 10 seconds nor the persistence time of the glow on any one test piece shall exceed 30 seconds.

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\*Glossary of terms relating to treated fabrics (*first revision*).



**3.4.2** The breaking load of the brattice cloth for warpway and weftway shall not be less than 40 kgf and 20 kgf respectively when tested in accordance with IS : 1969-1968\* on a specimen of 5 cm width.

**3.4.3 Accelerated Weathering Test** — The breaking load of the brattice cloth for warpway and weftway after storage in a humidity chamber maintained at  $70 \pm 1^\circ\text{C}$  and 100 percent relative humidity for 7 days shall be not less than 20 kgf and 10 kgf respectively ( see 3.4.2 ) on a specimen of 5 cm width.

**3.4.4 Air-Permeability** — The air-permeability of the materials shall be not more than  $10.0 \text{ m}^3/\text{min}/\text{m}^2$  at a pressure of 10 mm water gauge when tested in accordance with method given in Appendix B.

**3.4.5 Electrical Resistance (for Plastic Coated Brattice Cloth Only)** — The electrical resistance shall be not more than  $10^9$  ohms when determined between electrodes placed on the surface of the brattice cloth in accordance with the method prescribed in Appendix C.

#### **4. PACKING AND MARKING**

**4.1** The material shall be securely packed so as to ensure its safe transportation.

**4.2** Each roll of material shall be indelibly marked with the following information:

- a) Manufacturer's name or trade-mark, if any;
- b) Length and width of the material in metres;
- c) The mass of the treated fabric per square metre; and
- d) Month and year of manufacture.

**4.2.1** Each roll may also be marked with the ISI Certification Mark.

**NOTE** — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

#### **5. SAMPLING**

**5.1** Representative samples of the material shall be drawn as prescribed in Appendix D.

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\*Method for determination of breaking load and elongation at break of woven textile fabrics.

## 5.2 Number of Tests and Criteria for Conformity

**5.2.1** From each of the rolls selected, sufficient length of brattice cloth shall be cut, care being taken to exclude not less than 0.25 m of cloth from either end. The test specimens necessary for the various tests specified in the standard shall be cut from the brattice cloth thus obtained.

**5.2.2** Each of the lengths so obtained from a lot shall be examined for length and width (3.2) and if found satisfactory shall be further tested as specified in the relevant clauses of this standard.

**5.2.3** The lot shall be declared as conforming to requirements of this specification, if for each of the requirements referred to under 3.2 to 3.4, the test results on all the individual specimens are found to be within the limits specified.

# APPENDIX A

## ( Clause 3.4.1 )

### FIRE-RESISTANCE TEST

#### A-1. APPARATUS

**A-1.1 Barthel Burner** — The Barthel burner shown in Fig. 1 shall have a jet of 0.8 mm diameter with a flame gauze of aperture 0.50 mm over it. The diameter of the flame tube shall be 20 mm.

**A-1.2 Stand for Flame Test** — as shown in Fig. 2.

**A-1.2.1** A suitable test stand consists of a clamp and light steel framework to hold the Barthel burner and test piece in the required position during the test. The frame is 450 mm wide and 750 mm high with feet about 300 mm long. The test piece is suspended from the top cross bar of the stand by means of a spring clip. The lower corner of the test piece is slipped into a simple fork formed by a longitudinal saw cut in the end of a steel strip. The steel strip shall be not larger than 9.5 mm wide and 3 mm thick. The fork is fixed to the stand and serves to hold the test piece steady during the test.

**A-1.2.2** A rotating bracket is attached to the opposite side of the stand with arrangements for clamping the Barthel burner at an angle of 45° to the vertical. The Barthel burner may be secured to the bracket by means of a set screw passing through the bracket and engaging with a tapped hole arranged in the underside of the burner base or by other suitable means. By means of the bracket the burner may be swung so that the flame either plays on the test piece or is well clear of it.

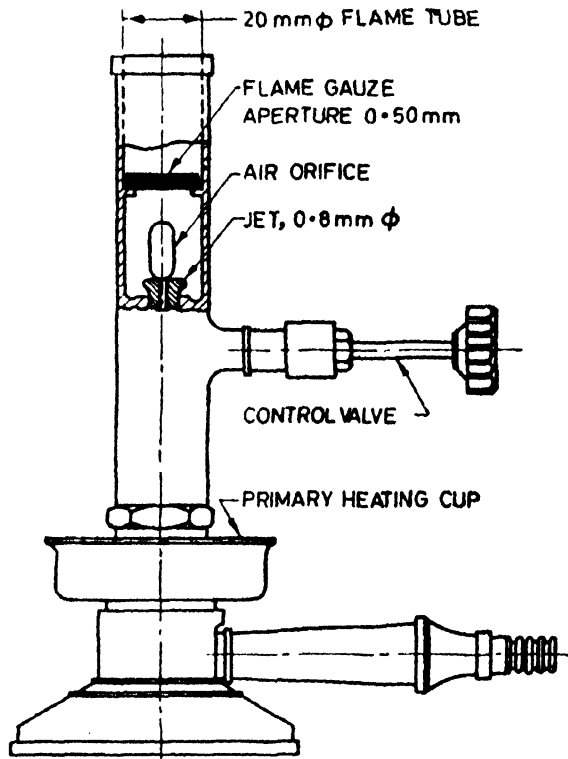
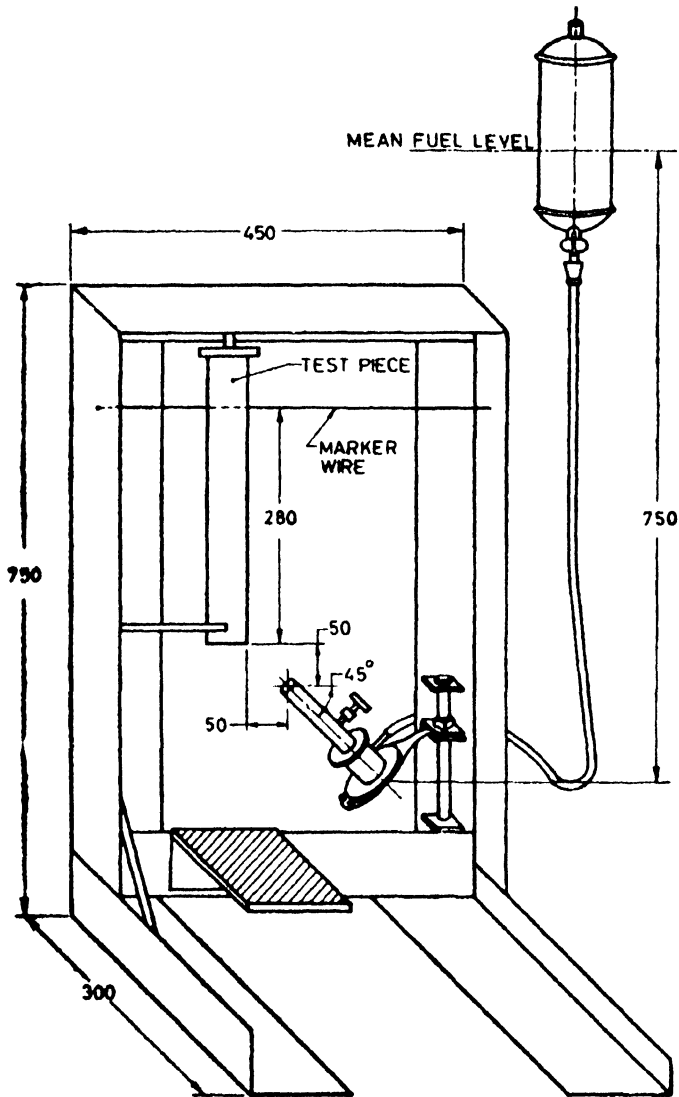


FIG. 1 BARTHEL BURNER

**A-1.2.3** The fuel container for the burner is clamped on to the side of the test cabinet so that the mean fuel level is approximately 750 mm above the base of the burner.

**A-1.2.4** The position of the burner in its clamp is adjusted so that when in the test position the centre of the burner mouth is 50 mm below and 50 mm to one side of the nearer lower corner of the test piece, with the flame burning in the plane of the test piece.

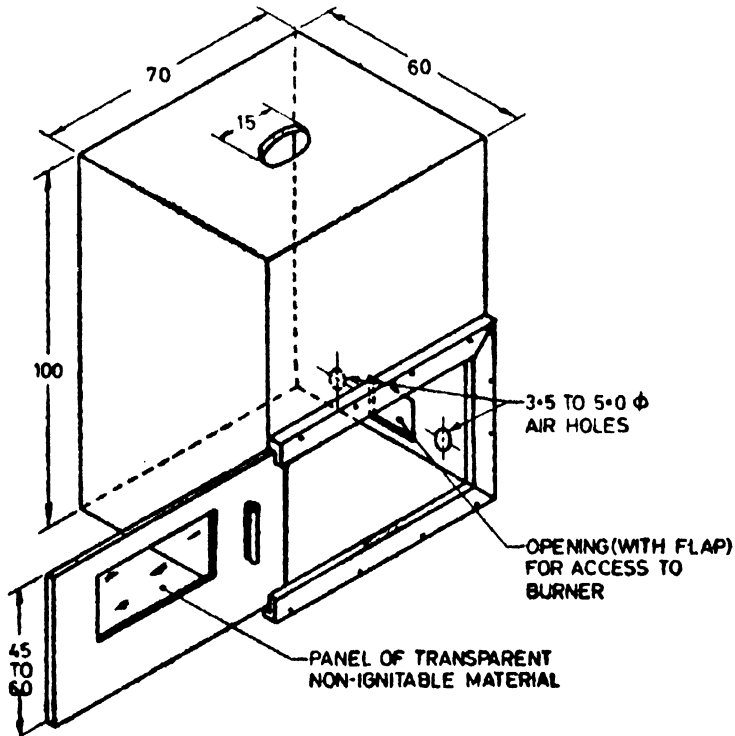
**A-1.2.5** A small asbestos-covered table is fixed to the stand approximately 150 mm below the bottom edge of the test piece when in the test position. This table serves to catch any falling portion of the burning test piece.



All dimensions in millimetres.  
FIG. 2 STAND FOR FIRE RESISTANCE TEST

**A-1.2.6** A marker wire is stretched horizontally across the stand behind the test piece and is set 280 mm above the bottom edge of the test piece.

**A-1.3 Draught-Free Cabinet**— A draught-free cabinet illustrated in Fig. 3, inside which the test stand is placed to carry out the test, consists of a box with a dark interior, approximately 700 mm wide, 1 000 mm high and 600 mm deep with a 150-mm diameter hole at the top to allow fumes to escape. The test stand is placed inside the cabinet and a hand hole (with flap) is provided at the side of the cabinet to permit handling the burner. A sliding door with a panel of transparent non-ignitable plastic or similar material is provided on the front of the cabinet.



All dimensions in centimetres.

FIG. 3 DRAUGHT-FREE CABINET

## A-2. CONDITIONING OF TEST SPECIMENS

**A-2.1** Each of the six test pieces, 50 × 450 mm in size, shall in turn be bent around a fixed 5 mm diameter rod as shown at (a) in Fig. 4. Each

test piece shall be pulled from one end to the other so that it is in the position shown at (b) in Fig. 4 and then back to the position shown at (a) in Fig. 4. During the whole operation the test piece shall be in contact with 180° of the surface of the rod. The cycle of two movements shall then be repeated ten times for each test piece. Each test piece shall then be turned over and the procedure repeated to 10 complete cycles. All loose material shall then be shaken off the test pieces.

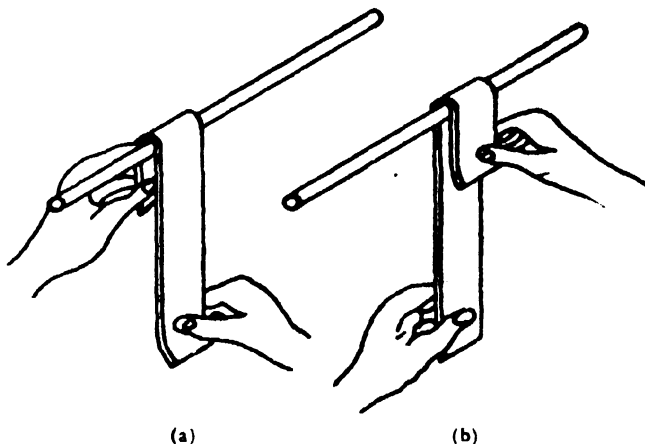


FIG. 4 METHOD OF CONDITIONING TEST SPECIMENS

**A-2.1.1** A 50-mm length shall be cut from each end of each test piece and all six test pieces then submerged in at least 2 litres of water at room temperature for 3 hours. At the end of the period of immersion, the test pieces shall be thoroughly dried at a temperature not exceeding 50°C, thereafter conditioned by free suspension at normal room temperature and humidity with both sides freely exposed to the atmosphere for at least 12 hours.

### A-3. TEST CONDITIONS

**A-3.1** The tests shall be made in subdued light in the draught-free cabinet.

**A-3.2** The Barthel burner shall be supplied with fuel consisting of 95 percent (*v/v*) ethanol and 5 percent (*v/v*) methanol and the mean fuel level shall be approximately 750 mm above the base of the burner. The visible flame shall be adjusted to a height of 180 mm above the top of the burner with the latter in the vertical position. The adjustment of the flame height shall be made against the dark background of the draught-free enclosure.

**A-3.2.1** The satisfactory operation of the burner shall be checked by holding a bare copper wire of 0.71 mm diameter and having a free length of not less than 100 mm at right angles to the axis of the burner. It shall be held in this position in the flame 50 mm above the top of the burner so that the free end of the wire extends up to the edge of the flame on the side remote from the supported end of the wire. If the wire takes more than 6 seconds to melt, the burner is not functioning properly for the purpose of the test.

#### **A-4. PROCEDURE**

**A-4.1** Six test pieces, each 50 × 450 mm, immediately after conditioning in accordance with **A-2**, shall in turn be mounted in the test stand.

**A-4.2** Each test piece shall be held in the burner flame for the prescribed time and the burner and flame shall then be swung clear of the test piece. The six test pieces in each group shall in turn be held in the burner flame for 20 seconds.

**A-4.3** The behaviour of each test piece shall be closely and continuously observed from the time the flame is first applied until at least 30 seconds after any flame or glow on the test piece is extinguished.

**A-4.4** If satisfactory observations for the time taken by flame or glow to disappear are not possible to be made due to any of the six test pieces shrivelling or melting away during the 20-second exposure to burner flame, further tests on six more test pieces shall be carried out with the exposure reduced to 10 seconds. When in accordance with the foregoing the reduced exposure time of 10 seconds becomes applicable, this shall be stated in the test report.

## **APPENDIX B**

*( Clause 3.4.4 )*

### **TEST FOR AIR-PERMEABILITY**

#### **B-1. APPARATUS**

**B-1.1** The apparatus consists of an approximately 1 000 × 200 mm cylindrical metallic drum with one end hermetically sealed and having a flange at the other end. It is connected through a tapping to a manometer and through another tapping to a flowmeter which in its turn is connected through a T-piece to an air pump.

**B-2. PROCEDURE**

**B-2.1** Fasten a sample of brattice cloth to the open end of the drum and flange securely. Start the air pump and examine for any leaks through the periphery of the mounting or at any connections with other parts of the apparatus. Correct the leaks and start the air pump with initial slow speed gradually raising it to obtain the required air pressure as far as possible. By manipulation of the T-piece, ensure that except for the initial rise, pressure remains constant. Read the pressure from the manometer and amount of air in cubic metres that is passing through the system per minute from the flowmeter. Conduct the test at an initial pressure of approximately 5 mm H<sub>2</sub>O gauge and at several other pressures up to 15 mm H<sub>2</sub>O gauge. Calculate permeability according to **B-3**. Plot permeability values *versus* air pressure and read off the value at 10 mm H<sub>2</sub>O gauge from the graph. Repeat the test at least at six random locations of a 2-metre sample. Report the mean of all the values as the final result.

**B-3. CALCULATION**

$$\text{Air permeability} = \frac{V}{A}$$

where

*V* = rate of flow of air in cubic metres per minute, and

*A* = area of brattice cloth in square metres exposed to air pressure.

**APPENDIX C**

( Clause 3.4.5 )

**TEST FOR ELECTRICAL RESISTANCE**

**C-1. TEST PIECES**

**C-1.1** Cut two test pieces of 300 mm square from the material.

**C-2. CONDITIONING**

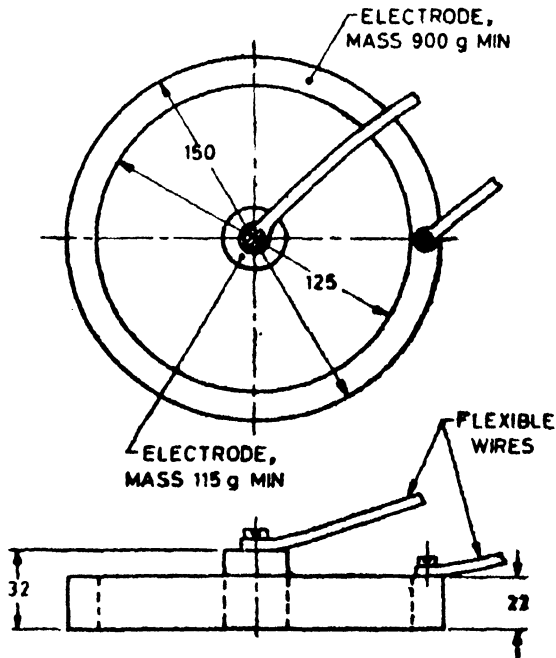
**C-2.1** Prior to evaluation, condition the test pieces in a standard atmosphere of  $65 \pm 5$  percent relative humidity and  $27 \pm 2^\circ\text{C}$  for at least 2 hours and immediately test at that temperature.



**C-3. APPARATUS**

**C-3.1** The apparatus shall consist of:

- a) a plate of insulating material, slightly larger than the test piece ( a clean sheet of polyethylene, or other material with resistivity not less than that of polyethylene, and 1.5 mm thick or more is recommended );
- b) two cylindrical and coaxial brass electrodes, the base of one being circular and the other annular, of dimensions and mass given in Fig. 5. The bases of the electrodes shall be machined and polished. A flexible insulated wire is connected to each electrode;
- c) a resistance measuring instrument capable of giving readings between  $10^6$  and  $10^{10}$  ohms and accurate to within  $\pm 5$  percent of the true value over this range; and
- d) a source of direct current at 1 000 volts maximum.



All dimensions in millimetres.

**FIG. 5 ASSEMBLY FOR TESTING ELECTRICAL RESISTANCE**

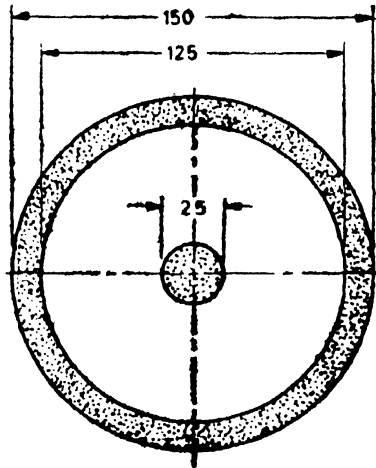
#### C-4. PROCEDURE

**C-4.1** Clean the surfaces of the test piece by dusting and rubbing with Fuller's earth using a clean pad of cloth or cotton wool. After all traces of the powder have been cleaned away, wipe the surface with a clean cloth moistened with distilled water and dry it with a clean cloth.

**C-4.2** On one of the surfaces of the test piece, paint two circles, the dimensions of which are given in Fig. 6 with a liquid consisting of:

- a) 800 parts by mass of anhydrous polyethylene glycol of molecular mass 600,
- b) 200 parts by mass of water, and
- c) 1 part by mass of soft soap;

or other conducting liquid having at least the same electrical conductivity.



All dimensions in millimetres.

FIG. 6 DESIGN TO BE PAINTED ON TEST PIECE

**C-4.2.1** It is important that the circles should be accurately painted and any excess liquid should be wiped away with a clean cotton wool pad. After drying ensure that the resistance between any two points on one or the other of the painted rings does not exceed  $10^6$  ohms; otherwise discard the test piece and prepare a fresh sample.

**C-4.3** Place the test piece on the piece of insulating material, with the painted rings on the top. Clean the lower faces of the electrodes and place these accurately over the painted rings on the test piece.

**C-4.3.1** If the sample does not have a flat surface the contact between the surface and electrodes may be improved by first placing on each painted ring on the test piece a sheet of metal foil cut to the same dimensions as the rings. The electrodes are then placed on the foil.

**C-4.4** Connect the outer electrode to the earth or low voltage terminal of the measuring instrument and the inner electrode to the high voltage terminal. The leads should not touch each other, the test piece or any part of the apparatus except the terminals to which each is connected.

**C-4.5** Measure the resistance by applying the voltage for at least one minute.

**C-4.6** Ensure when reading the resistance that it does not change appreciably when pressure is exerted over the electrodes. Take care not to breathe on the test piece as any condensation of moisture on the surface will falsify the results. Repeat the test on the other face of the test piece.

**C-4.7** For each face of the test piece the electrical resistance shall be expressed as the mean of the values noted for the two test pieces. The electrical resistance of the two faces shall be reported separately.

## APPENDIX D

( Clause 5.1 )

### SAMPLING OF BRATTICE CLOTH

#### D-1. LOT

**D-1.1** In any consignment, all the rolls of the same size and drawn from a single batch of manufacture shall constitute a lot.

**D-1.2** The conformity of the lot to the requirements of the specification shall be ascertained for each lot separately. The number of rolls to be selected for this purpose shall be as given below:

<i>Lot Size</i> ( <i>N</i> )	<i>No. of Rolls to be Selected</i> ( <i>n</i> )
Up to 50	2
51 „ 100	3
101 „ 200	4
201 „ 300	5
301 and above	7

**IS : 4353 - 1977**

**D-1.3** The rolls shall be selected at random\* and to ensure randomness of selection, the following procedure is recommended for use:

Arrange all the rolls in the lot in a systematic manner and starting from any one, count them as 1, 2, ....., up to  $r$  and so on, where  $r$  is the integral part of  $N/n$  (see **D-1.2**). Every  $r$ th roll thus counted shall be withdrawn till the requisite number of rolls is obtained.

**D-1.4** All the rolls selected in **D-1.3** shall constitute the test samples.

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\*See also IS : 4905-1968 Methods for random sampling.

## BUREAU OF INDIAN STANDARDS

### *Headquarters :*

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 3 31 01 31, 3 31 13 75

Telegrams : Manaksanstha  
( Common to all Offices )

### *Regional Offices :*

*Telephone*

\*Western ; Manakalaya, E9 MIDC, Marol, Andheri ( East ), 6 32 92 95  
BOMBAY 400093

†Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, 36 24 99  
Maniktola, CALCUTTA 700054

Northern : SCO 445-446, Sector 35-C { 2 18 43  
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Southern : C. I. T. Campus, MADRAS 600113 { 41 24 42  
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### *Branch Offices :*

Pushpak, Nurmohamed Shaikh Marg, Khanpur, { 2 63 48  
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'F' Block, Unity Bldg, Narasimharaja Square, 22 48 05  
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Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, 6 27 16  
BHOPAL 462003

Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002 5 36 27

53/5 Ward No. 29, R. G. Barua Road,  
5th Byelane, GUWAHATI 781003 —

5-8-56C L. N. Gupta Marg, (Nampally Station Road), 22 10 83  
HYDERABAD 500001

R14 Yudhister Marg, C Scheme, JAIPUR 302005 { 6 34 71  
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**AMENDMENT NO. 1 MARCH 2002  
TO  
IS 4355 : 1977 SPECIFICATION FOR FIRE-RESISTANT  
BRATTICE CLOTH  
( *First Revision* )**

( *Page 5, clause 3.4.3, line 3* ) — Substitute '90 ± 2' for '100'.

( PCD 13 )

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Reprography Unit, BIS, New Delhi, India